AIRS/AMSU/HSB data assimilation

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AIRS Data Assimilation Workshop

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- Larry McMillin, NOAA/NESDIS/ORA
- Mitch Goldberg, NOAA/NESDIS/ORA
- Tom Kleespies, NOAA/NESDIS/ORA

Radiative Transfer Model

- Create a community model
  - For use by NOAA, NASA, and others
- Supply all components
  - Forward model
  - Tangent-linear
  - Adjoint
  - Jacobian
- Modular design of code
  - Anticipating changes/additions to algorithms.
  - Fortran-9X makes this easier.
- OS/Platform portability
  - Use ANSI/ISO code standards.

Operational Issues

- Same code for all satellites/instruments
  - RTM improvements will apply to all satellites
  - New instruments can be accommodated in one framework
- Both infrared and microwave sensors
- NCEP operational performance standards
  - RTM has to be fast enough for data assimilation
- Ongoing maintenance and support

Science Issues

- Transmittance model "engine".
  - OPTRAN, PFAAST, or hybrid?
- Line-by-line (LBL) updates.
  - Spectral line parameters
  - Spectral line formulation
  - LBL model
    - LBLRTM
      - ~6 month calculation time
    - kCARTA
      - Spectroscopy can be improved relatively quickly
      - Fast calculation times
- Coordinate RTM generation with NESDIS
  - Larry McMillin and Tom Kleespies

Reflected thermal radiation

- Currently:
  - Transmittance used for calculating the downwelling flux is derived from the upwelling transmittance. O.K. for μW. Not so good for IR.
  - Specular reflectivity only.

- New:
  - Downwelling flux transmittance calculated separately using diffusivity approximation (IR).
  - Isotropic reflectivity option.
  - Cosmic background term (μW).

Reflected solar radiation

- Currently:
  - No solar term.
- New:
  - Downwelling directional transmittance at solar zenith angle calculated separately.
  - Precalculated TOA solar spectrum (Kurucz) used only for sensitive channels.
- Is diffuse solar important?

Transmittance model predictors

- Currently:
  - OPTRAN coefficients are generated for level valued predictors.
  - NCEP GDAS does not supply the level temperature/mixing ratios.
  - Predictor formulation in operational model is close but inconsistent with transmittance model coefficient generation (not unique to OPTRAN).

- Planned:
  - Update predictors to use GDAS output directly.
  - Only impacts the integrated, or scaled, predictors.

GDAS bias correction

- Scan bias.
- Bias due to RT, calibration, and model errors.
  - Performed within analysis system

$$b = \sum_{i=1}^{4} a_i c_i$$

  - Predictors (c_i) based on zenith angle and integrated lapse rate.
  - Coefficient (a_i) update allows for constant and smooth evolution of bias correction coefficients. Less sensitivity to instrument problems (e.g. N15 HIRS)

GDAS quality control

ssimilation system sensitive to contaminated
ata, so some good data rejected.

- Quality control is conservative

urrent main criteria - ch8 HIRS within ±1K,
bs-calc, over ocean, clear only.

- AIRS has more window channels, so more checks likely. Cooperate with Larry McMillin/Mitch Goldberg in determining these.

hannel obs-calc < 3σ

an use cloudy data if cloud top height known
ich that channel does not "see" the cloud.